RMAG-9709-001

Visible, Infrared, and Multispectral Airborne Sensor Support Data Extensions (SDE)

for the

National Imagery Transmission Format (Version 2.0)

of the

National Imagery Transmission Format Standards

Version 0.9

25 September 1997

Paragraph

Figure	Page

Table	Page

1. SCOPE

1.1. Scope.

This appendix specifies the format and content of a set of controlled tagged record extensions for the National Imagery Transmission Format (NITF v2.0) file format. The specified tagged records incorporate all Support Data Extensions (SDE) relevant to visible/infrared/multispectral/ hyperspectral (EO-IR-MSI-HSI) primary, but they are not yet explicitly included. The information which makes up the SDE is derived from referenced interface documents. Systems using visible, or infrared imagery formatted according to NITF 2.0 from airborne sensors should be designed to extract the needed data from the tagged records described herein.

1.2. Content.

This appendix provides a detailed description of the overall structure, as well as specification of the valid data content and format, for all fields defined within each specified SDE. In addition, technical information is presented to provide a general understanding of the significance of the included fields.

1.3. Applicability.

The applicability of this appendix is inherited from the NITF 2.0 standard. It is applicable to all new Department of Defense equipment and systems, and those undergoing major modification, having a requirement to support airborne EO-IR and multispectral imagery. These systems shall conform to the NITF 2.0 standard, including the SDEs described in this appendix.

1.4. Certification.

Pertinent compliance requirements are defined in Joint Interoperability Engineering Organization (JIEO) Circular 9008, National Imagery Transmission Format Certification Test and Evaluation Plan.

2. APPLICABLE DOCUMENTS

2.1. Government documents

2.1.1. Specifications, standards and handbooks.

The following documents form a part of this document to the extent specified. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS).

MILITARY STANDARDS

MIL-STD-2500A	National Imagery Transmission Format (NITF) for the National Imagery Transmission Format Standards (NITFS), 12 October 1994.

MILITARY HANDBOOKS

MIL-HDBK-1300	National Imagery Transmission Format Standard (NITFS) Handbook, 30 June 1993.

(Copies of the above NITFS documents may be obtained from DODSSP, Subscription Services Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094, telephone (215) 697-2569)

2.1.2. Other Government documents, drawings, and publications.

The following Government documents form a part of this document to the extent specified. Unless otherwise specified, the issues of these documents are those cited in the solicitation.

DISA/JIEO Circular 9008	NITFS Certification Test and Evaluation Program Plan

(Copies of the above NITFS document may be obtained from Joint Interoperability Test Center, Attn: TCDBA, Bldg. 57305, Ft, Huachuca, AZ 85613-7020, telephone (520) 538-5154.)

DIAM-65-3-1	Standard Coding Systems Functional Classification Handbook, Defense Intelligence Agency, July 1995.
RASG-9606-001	Airborne Synthetic Aperture Radar Support Data Extensions for the National Imagery Transmission Format, 20 May 1996.
CIO-2047	Support Data Extensions (version 1.1) for the National Imagery Transmission Format (Version 2.0) of the National Imagery Transmission Format Standard (TS), 15 April 1995.

2.1.3. Non-Government publications.

The following documents form a part of this document to the extent specified. Unless otherwise specified, the issues of the documents that are adopted by the DoD are those listed in the issue of the DODISS cited in the solicitation.

NATIONAL STANDARDS

ANSI X3.4 - 1986	American National Standard Code for Information Interchange (ASCII), 1986.

(Copies of the above document are available from American National Standards Institute (ANSI) Sales Department, 1430 Broadway, New York, NY 10018, telephone: (212) 642-4900.)

3. DEFINITIONS

3.1. Acronyms

Field Names and Values contained in the various tables of this document are not replicated in this list.

A/C	Aircraft
ANSI	American National Standards Institute
ASCII	American National Standard Code for Information Interchange
BE	Basic Encyclopedia
CCRP	Collection Central Reference Point
DODIIS	Department of Defense Intelligence Information System
ECF	Earth Centered Fixed Coordinate System
EMTI	Enhanced Moving Target Information
EO	Electro-Optical (Visual)
HSI	Hyperspectral Imagery
ID	Identification
INS	Inertial Navigation System
IR	Infrared
JIEO	Joint Interoperability Engineering Organization
MSI	Multispectral Imagery
MSL	Mean Sea Level
NED	North East Down Coordinate System
NITF	National Imagery Transmission Format
NITFS	National Imagery Transmission Format Standards
RPM	Rigorous Projection Model
SAR	Synthetic Aperture Radar
SDE	Support Data Extension
TBD	To Be Determined
UTC	Coordinated Universal Time
WAMTI	Wide-Area Moving Target Information

4. GENERAL REQUIREMENTS

4.1. Support Data Extensions (SDEs).

Support data is that information needed to interpret or disseminate associated sensor data and includes mission, platform and sensor dynamic, and sensor static information. That set of support data needed to accomplish the mission of a system receiving a NITF 2.0 file is referred to as "appropriate" support data. The appropriate support data may vary across systems receiving NITF 2.0 files. A system receiving a NITF 2.0 file may add or subtract support data before passing the file to another system with a different mission. This strategy implies a modular support data definition approach.

4.1.1. Sources of Support Data.

Sensors collecting imagery also collect and report auxiliary data that uniquely identifies the imagery, defines the collection geometry, and contains other information to aid exploitation of that imagery. The extensions described herein define the format for that support information within a NITF 2.0 file containing visible or infrared imagery.

4.1.2. Specification Change Impacts.

Imagery providers generating these SDEs may continue to generate them even if the sensors change; this allows commercial systems to base their software on the SDEs. Revisions to these NITF Extensions, or to the NITF itself, will have associated transition plans to accommodate existing users.

4.1.3. Defined Support Data Extensions.

Table 1 lists all of the support data extensions described in this document, and whether they are required for all airborne imagery. They are defined for use with visible (EO), infrared (IR) and multispectral imagery (MSI) collected on airborne sensor platforms. Several are similar to existing and proposed extensions developed by other programs and sensors, including airborne Synthetic Aperture Radar (SAR), and can be considered aliases to those extensions (e.g., AIMIDA is nearly identical with STDIDC used for commercial satellite imagery). Where original fields are not applicable to airborne EO-IR imagery, *reserved* fields, identified by names of the form “(reserved-nnn)” maintain alignment between the original and aliased extensions. Extensions defined for airborne SAR sensors that are applicable to EO-IR sensors are shaded in Table 1 and are shown in this document only for reference.

Table 1 Airborne Visible, Infrared, and Multispectral Support Data Extensions

Tag	Title	Requirement
AIMID	Additional Image Identification	Required
ACFT	Aircraft Information	Required
BLOCK	Image Block Information	Optional
SECTG	Secondary Targeting Info	Optional
BANDS	Multispectral Band Parameters	Optional
EXOPT	Exploitation Usability Optical Information	Optional
MSTGT	Mission Target	Optional
RPC00	Rapid Positioning Data	Optional
SENSR	EO-IR Sensor Parameters	Required
STERO	Stereo Information	Optional

Each tag ends with a revision letter; the initial definition will use the revision letter “A”. Revised tags will have names ending in “B” (“C”,”D”, etc.) as revisions are approved. A transition plan for implementing tag changes shall accompany any such revisions (typically, for a period of time, both the “A” and “B” versions should be supported for receivers of NITF products). SDE fields affected by version changes can contain ASCII blanks (hex 20) for transition between the versions.

The section which describes the purpose of an extension is titled without the revision letter, such that if the extension were to change, the purpose paragraph would not require changing. For example, section 5.3 describes the ACFT or Aircraft Information extension. The actual tag, however, is ACFTA. If in the future, a change is made, section 5.3 will continue to describe the ACFT or Aircraft Information extensions, but would include a definition of both the ACFTA and ACFTB tagged extensions.

4.2. Technical Notes on Coordinate Systems.

4.2.1. Locations.

Figure 1 shows the earth coordinate frame, the local North-East-Down (NED) coordinate frame, and the platform location parameters: latitude and longitude. The platform location parameters define the location in earth coordinates of the sensor platform, or more specifically, the platform center of navigation. The center of navigation is the origin of the local NED coordinate frame. The local NED coordinates are North (N), East (E), and Down (D) as shown.

The location of the center of navigation within the platform defined uniquely for each platform and sensor.

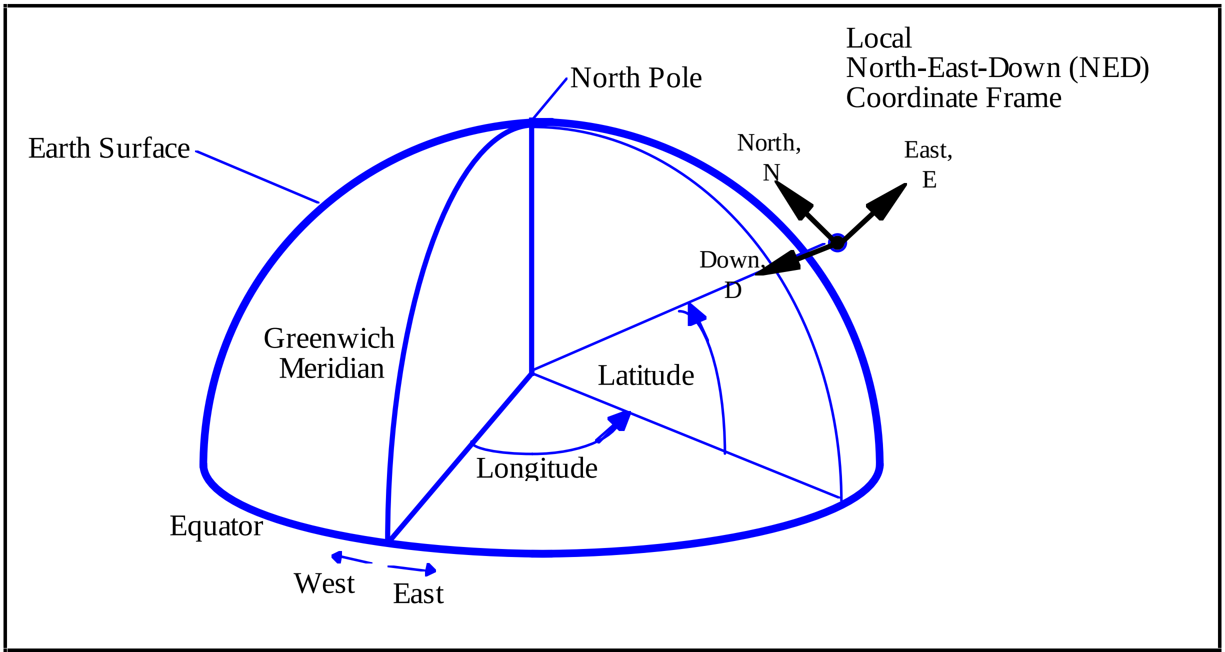

Figure 1 Platform Location Coordinates

The earth surface in Figure 1 is described in the World Geodetic System of 1984 (WGS-84) as two different model surfaces. The two surfaces are an ellipsoid and a geoid (see Figure 2). The ellipsoid is an ideal mathematical surface; the geoid is the mean-sea-level surface of the earth as determined by gravitational potential (elevation of the geoid relative to the ellipsoid varies with location from -102 to +74 meters). Platform latitude and longitude are referenced to the ellipsoid, while platform altitude mean sea level (MSL) is defined with respect to the geoid: Altitude MSL is the vertical distance from mean sea level to the platform. The Global Positioning System is referenced to the ellipsoid.

The Down-axis (D) of the NED coordinate frame lies normal to the geoid. That is, D lies in the direction of gravitational acceleration. The North-axis (N) and East-axis (E) lie in the geometric plane perpendicular to D (the horizontal plane), with N in the direction of True North.

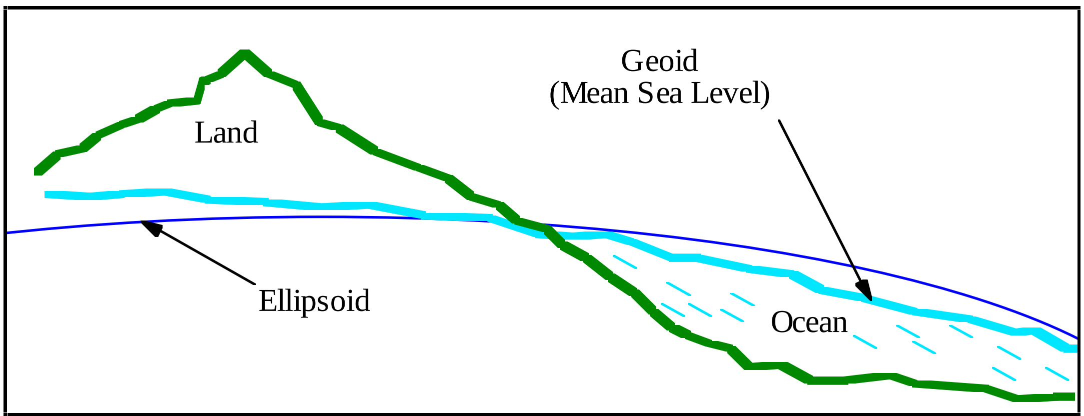

Figure 2 Ellipsoid and Geoid Models of the Earth Surface

4.2.2. Attitude Parameters: Heading, Pitch, And Roll.

Heading, pitch, and roll relate the platform body coordinate frame to the local NED frame. Figure 3 shows the platform body coordinates. X_a is positive forward, along the roll axis. Y_a is positive right, along the pitch axis. Z_a is positive down, along the yaw axis. The platform body frame, like the local NED frame, has its origin at the center of navigation. Heading is the angle from north to the NED horizontal projection of the platform positive roll axis, X_a (positive from north to east). Pitch is the angle from the NED horizontal plane to the platform positive roll axis, X_a (positive when X_a is above the NED horizontal plane), and is limited to values between ±90 degrees. Roll is the rotation angle about the platform roll axis. Roll is positive if the platform positive pitch axis, Y_a (right wing) lies below the NED horizontal plane.

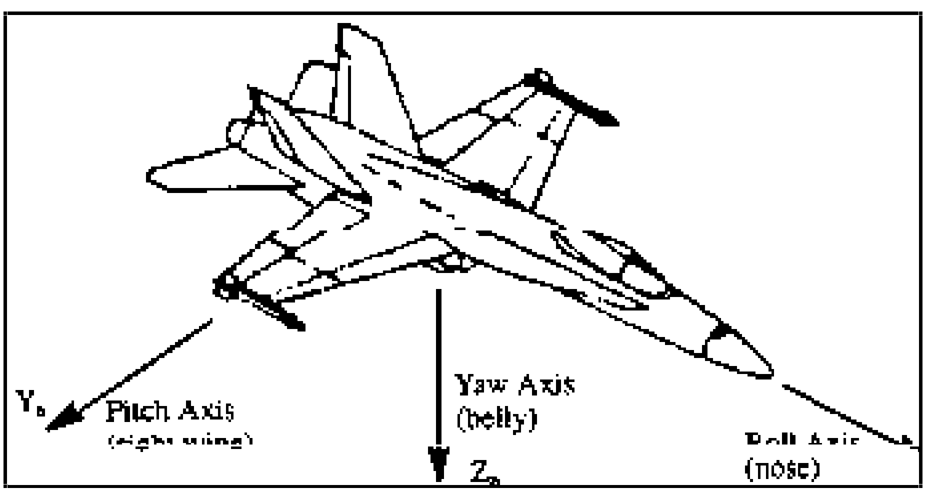

Figure 3 Platform Body Coordinate Frame

5. DETAILED REQUIREMENTS

5.1. Generic Tagged Extension Mechanism.

The tagged record extensions defined in this document are "controlled tagged record extensions" as defined in Section 5.9 of MIL-STD-2500. The tagged record extension format is summarized here for ease of reference. Table 2 describes the general format of a controlled tagged record extension.

Table 2 Controlled Tagged Record Extension Format

(TYPE “R” = Required, “C” = Conditional, <> = null data allowed)

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
CETAG	Unique extension type identifier, a valid alphanumeric identifier properly registered with the NITF Technical Board.	6	Alphanumeric	n/a	R
CEL	Length of CEDATA field. The length in bytes of the data contained in CEDATA. The tagged record's overall length is the value of CEL + 11.	5	00001 to 99985	Bytes	R
CEDATA	User-defined data. This field shall contain data primarily of character data type (binary data is acceptable for extensive data arrays, such as color palettes or look-up tables) defined by and formatted according to user specification. The length of this field shall not cause any other NITF field length limits to be exceeded but is otherwise fully user defined.	*	User-defined	n/a	R

* equal to value of CEL field.

The CETAG and CEL fields essentially form a small (11 byte) tagged record subheader. The format and meaning of the data within the CEDATA field is the subject of this document for several, individual controlled tagged record extensions.

Multiple tagged extensions can exist within the tagged record extension area. There are several such areas, each of which can contain 99,999 bytes worth of tagged extensions. There is also an overflow mechanism, should the sum of all tags in an area exceed 99,999 bytes. The overflow mechanism allows for up to 1 Gbyte of tags.

While the extensions defined in this document will typically be found in the image subheader, it is possible that they could appear in a Data Extension Segment which is being used as an overflow of the image subheader.

If the information contained within an extension is not available, the extension will not be present in the file. For example, if the image is not part of a stereo set, the STERO extension will not be present. The set of extensions stored within the file can change over the lifetime of the image, due to additional information, removal of outdated information, or change in classification. Table 1 indicates which extensions must appear in every file and which may be omitted.

When an extension is present, all of the information listed as Required (type = “R”) must be filled in with valid information. Information listed as Conditional (type = “C”) may or may not be present, depending upon the value in a preceding field; conditional fields that are not present occupy no space in the file. Information identified with angle brackets (type = “<R>” or “<C>”) may contain valid information, or may contain ASCII spaces (i.e., hex 20) to indicate a null field - that valid data is unavailable.

Alphanumeric values that do not fill the allotted space are left justified within a field, and the remaining bytes are filled with ASCII spaces (i.e., hex 20). Numeric values are right justified within the field, with ASCII zeros (i.e., hex 30) extending to the left field boundary.

Reserved fields, identified by names of the form “(reserved-nnn)” maintain alignment and functional equivalence with similar extensions defined for systems beyond the scope of this document. The content of reserved fields are explicitly specified in the Value Range column. Systems generating these extensions shall insert the specified value into each reserved field; systems interpreting them may ignore the contents of reserved fields.

5.2. AIMID — Additional Image ID.

The Additional Image ID extension is used for storage and retrieval from standard imagery libraries. AIMID is a required component of all airborne imagery files. The format and description for the user defined fields of the AIMIDA extension are detailed in Table 3. A single AIMIDA is placed in the Image Subheader; where several images relate to a single scene, an AIMIDA may be placed in each applicable Image Subheader. Note that the fields from ACQUISITION_DATE through END_TILE_ROW, inclusive, constitute the ST_ID field in the STEROB extension of a stereo mate image.

Table 3 AIMIDA — Additional Image ID Extension Format

(TYPE “R” = Required, “C” = Conditional, “<> = null data allowed)

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
CETAG	Unique Extension Identifier.	6	AIMIDA	n/a	R
CEL	Length of Entire Tagged Record.	5	00089	Bytes	R
The following fields define AIMIDA					
ACQUISITION_DATE	Acquisition Date. This field shall contain the date and time, referenced to UTC, of the collection in the format YYYYMMDDhhmmss, in which YYYY is the year, MM is the month (01–12), DD is the day of the month (01-31), hh is the hour (00-23), mm is the minute (00-59), and ss is the second (00-59). This field is equivalent to the IDATIM field in the Image Subheader.	14	YYYYMMDDhhmmss		R
MISSION	Mission Identification. Fourteen character descriptor of the mission. Contents are user defined.	14	Alphanumeric		R
FLIGHT_NO	Flight Number. Each flight shall be identified by a flight number in the range 01 to 09. Flight 01 shall be the first flight of the day, flight 02 the second, etc. In order to ensure uniqueness in the image id, if the aircraft mission extends across midnight UTC, the flight number shall be 0x (where x is in the range 0 to 9) on images acquired before midnight UTC and Ax on images acquired after midnight UTC; for extended missions Bx, … Zx shall designate images acquired on subsequent days.	2	01 to 09 A1 to A9 B1 to B9 … Z1 to Z9		R
OP_NUM	Image Operation No. Reset to 001 at the start of each flight. A value of 000 indicates the airborne system does not number imaging operations. For video systems this field contains the frame number within the ACQUISITION_DATE time.	3	000 to 999		R

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
START_SEGMENT	Start Segment ID. Identifies images as separate pieces (segments) within an imaging operation. AA is the first segment, AB is the second segment, etc.	2	AA to ZZ		R
REPRO_NUM	Reprocess Number. For SAR imagery this field indicates whether the data was reprocessed to overcome initial processing failures, or has been enhanced. A "00" in this field indicates that the data is an originally processed image, a "01" indicates the first reprocess/enhancement, etc. For visible and infrared imagery this field shall contain “00” to indicate no reprocessing or enhancement.	2	00 to 99		R
REPLAY	Replay. Indicates whether the data was reprocessed to overcome initial processing failures, or retransmitted to overcome transmission errors. A "000" in this field indicates that the data is an originally processed and transmitted image, a value in the range of "G01" to "P99" indicates the data is reprocessed, and a value in the range of “T01” to “T99” indicates it was retransmitted.	3	000, G01 to G99, P01 to P99, T01 to T99		<R>
(reserved-001)		1	1 space		R
START_TILE_COLUMN	Starting Tile Column Number. For tiled (blocked) sub-images, the offset of the first tile in the cross-scan direction relative to start of the original image tiling. Tiles are rectangular arrays of pixels that subdivide an image.	3	001 to 999		R
START_TILE_ROW	Starting Tile Row Number. For tiled (blocked) sub-images, the offset of the first tile in the along-scan direction relative to start of the original image tiling.	5	00001 to 99999		R
END_SEGMENT	Ending segment ID of this file.	2	AA to ZZ		R
END_TILE_COLUMN	Ending Tile Column Number. For tiled (blocked) sub-images, the offset of the last tile in the cross-scan direction relative to start of the original image tiling.	3	001 to 999		R
END_TILE_ROW	Ending Tile Row Number. For tiled (blocked) sub-images, the offset of the last tile in the along-scan direction relative to start of the original image tiling.	5	00001 to 99999		R

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
COUNTRY	Country Code. Two letter code defining the country for the reference point of the image. Standard codes may be found in FIPS PUB 10-4.	2	AA to ZZ		<R>
(reserved-002)		4	4 spaces		R
LOCATION	Location of the natural reference point of the sensor, provides a rough indication of geographic coverage. The format ddmmX represents degrees (00-89) and minutes (00-59) of latitude, with X = N or S for north or south, and dddmmY represents degrees (000-179) and minutes (00-59) of longitude, with Y = E or W for east or west, respectively. For SAR imagery the reference point is normally the center of the first image block. For EO-IR imagery the reference point for framing sensors is the center of the frame; for continuous sensors, it is the center of the first line.	11	ddmmXdddmmY		R
(reserved-003)		13	13 spaces		R

5.3. ACFT — Aircraft Information

ACFT provides miscellaneous information unique to airborne sensors. The format and descriptions for the user defined fields of the ACFTA extension are detailed in Table 4. The ACFT extension is required.

Table 4. ACFTA — Aircraft Information Extension Format

(TYPE "R" = Required, "C" = Conditional, <> = null data allowed)

9	NAME	SIZE	VALUE RANGE	UNITS	TYPE
CETAG	Unique Extension Identifier.	6	ACFTA	n/a	R
CEL	Length of Entire Tagged Record.	5	00191	Bytes	R
The following fields define ACFTA					
AC_MSN_ID	Aircraft Mission Identification	20	Alphanumeric		R
AC_TAIL_NO	Aircraft Tail Number	10	Alphanumeric		<R>
AC_TO	Aircraft Take-off. Date and Time, referenced to UTC, in the format YYYYMMDDhhmm, in which YYYY is the year, MM is the month (01–12), DD is the day of the month (01-31), hh is the hour (00-23), and mm is the minute (00-59).	12	YYYYMMDDhhmm		<R>
SENSOR_ID	Sensor ID. Identifies which specific sensor produced the image. Examples: For Radar Imagery: ASARS-1 (Advanced SAR on SR-71) ASARS-2 (Advanced SAR on U-2) GHR (Global Hawk Radar) TSAR (Tactical SAR on Predator) For EO-IR, the first four characters of Sensor ID are expressed as ccff where cc indicates the sensor category: IH (High Altitude / Long Range IR) IM (Medium Altitude IR) IL (Low Altitude IR) VH (Visible High Altitude / Long Range) VM (Visible Medium Altitude) VL (Visible Low Altitude) VF (Video Frame) and ff indicates the sensor format: FR (Frame) LS (Line Scan) PB (Pushbroom) PS (Pan Scan)	10	Alphanumeric		R
SCENE_SOURCE	Scene Source. Indicates the origin of the request for the current scene. A scene is single image or a collection of images providing contiguous coverage of an area of interest. 0 = Pre-Planned 1-9 = Sensor Specific: For ASARS-2: 1 = Scene Update (uplink) 2 = Scene Update (manual - via pilot's cockpit display unit) 3 = Immediate Scene (immediate spot or search range adjust) 5 = Preplanned Tape Modification 6 = SSS Other Sensors: TBD.	1	0 to 9		R

9	NAME	SIZE	VALUE RANGE	UNITS	TYPE
SCNUM	Scene Number. Identifies the current scene, and is determined from the mission plan; except for immediate scenes, where it may have the value 0, the scenes are numbered from 1. The scene number is only useful to replay/regenerate a specific scene; there is no relationship between the scene number and an exploitation requirement.	6	000000 to 999999		R
PDATE	Processing Date. SAR: when raw data is converted to imagery. EO-IR: when image file is created. YYYY is the year, MM is the month (01–12), and DD is the day of the month (00-31). This date changes at midnight UTC.	8	YYYYMMDD		R
IMHOSTNO	Immediate Scene Host. Together with Immediate Scene Request Id below, denotes the scene that the immediate was initiated from and can be used to renumber the scene, Example: If the immediate scene was initiated from scene number 123 and this is the third request from that scene, then the scene number field will be zero, the immediate scene host field will contain 123 and the immediate scene request id will contain 3. Only valid for immediate scenes.	6	000000 to 000511		<R>
IMREQID	Immediate Scene Request Id	5	00000 to 32767		<R>
MPLAN	Mission Plan Mode. Defines the current collection mode. For ASARS-1: 001 - 005 = Search, submodes 1-5 006 - 010 = Op Spot, submodes 1-5 011 - 015 = Wideband Spot, submodes 1-5 For ASARS-2: 001 – Search 002 – Spot 3 004 – Spot 1 007 – Continuous Spot 3 008 – Continuous Spot 1 009 – EMTI Wide Frame Search 010 – EMTI Narrow Frame Search 011 – EMTI Augmented Spot 012 – EMTI Wide Area MTI (WAMTI) 013 – Monopulse Calibration For EO-IR: 001-003 – Reserved 004 – EO Spot 005 – EO Point Target 006 – EO Wide Area Search 014 – IR Spot 015 – IR Point Target 016 – IR Wide Area Search	3	001 to 016		R

9	NAME	SIZE	VALUE RANGE	UNITS	TYPE
In SAR Search mode and EO-IR Wide Area Search modes, the entry and exit locations are the specified latitude, longitude and altitude above mean sea level (MSL) of the planned entry and exit points on the scene centerline of the area to be imaged. In EO-IR and SAR Spot modes, and EO-IR Point Target modes, the entry location is the specified reference point latitude/longitude/altitude, and the exit location is not used. The location may be expressed in either degrees-minutes-seconds or in decimal degrees. The format ddmmss.ssX represents degrees (00-89), minutes (00-59), seconds (00-59), and hundredths of seconds (00-99) of latitude, with X = N for north or S for south, and dddmmss.ssY represents degrees (000-179), minutes (00-59), seconds (00-59), and hundredths of seconds (00-99) of longitude, with Y = E for east or W for west. The format ±dd.dddddd indicates degrees of latitude (north is positive), and ±ddd.dddddd represents degrees of longitude (east is positive).					
ENTLOC	Entry Location.	21	ddmmss.ssXdddmmss.ssY ±dd.dddddd±ddd.dddddd		<R>
ENTALT	Entry Altitude.	6	-01000 to +30000	feet or meters	<R>
ALT_UNIT	Unit of Altitude. Defines unit for Entry and Exit Altitudes. f=feet, m=meters	1	f or m		<R>
EXITLOC	Exit Location.	21	ddmmss.ssXdddmmss.ssY ±dd.dddddd±ddd.dddddd		<R>
EXITALT	Exit Altitude.	6	-01000 to +30000	feet or meters	<R>
TMAP	True Map Angle. SAR: In Search modes, the true map angle is the angle between the ground projection of the line of sight from the aircraft and the scene center line. In Spot modes, the true map angle is the angle, measured at the central reference point, between the ground projection of the line of sight from the aircraft and a line parallel to the aircraft desired track heading. EO-IR: The true map angle is defined in the NED coordinate system with origin at the aircraft (aircraft local NED), as the angle between the scene entry line of sight and the instantaneous aircraft track heading vector. The aircraft track heading vector is obtained by rotating the north unit vector of the aircraft local NED coordinate system in the aircraft local NE plane through the aircraft track heading angle. The true map angle is measured in the slanted plane containing the scene entry line of sight and the aircraft track heading vector. This angle is always positive.	7	000.000 to 180.000	degrees	<R>
ROW_SPACING	Row Spacing SAR: Ground plane distance between corresponding pixels of adjacent rows, measured in feet. EO-IR: Angle between corresponding pixels of adjacent rows, measured in microradians at center of image.	7	SAR: 00.0000 to 99.9999 EO-IR:0000.00 to 9999.99	ft μ-radians	<R>

9	NAME	SIZE	VALUE RANGE	UNITS	TYPE
COL_SPACING	Column Spacing SAR: Ground plane distance between adjacent pixels within a row, measured in feet. EO-IR: Angle between adjacent pixels within a row, measured in microradians at center of image.	7	SAR: 00.0000 to 99.9999 EO-IR:0000.00 to 9999.99	ft μ-radians	<R>
FOCAL_LENGTH	Sensor Focal Length. Effective distance from optical lens to sensor element(s). Not used for SAR.	6	SAR: 999.99 EO-IR: 000.01 - 999.99	cm	<R>
SENSERIAL	Sensor vendor's serial number. Serial number of the line replaceable unit (LRU) containing EO-IR imaging electronics or SAR Receiver/Exciter involved in creating the imagery contained in this file.	6	000001 to 999999		<R>
ABSWVER	Airborne Software Version. Airborne software version (vvvv) and Revision (rr) numbers.	7	vvvv.rr		<R>
CAL_DATE	Calibration Date. Date sensor was last calibrated. YYYY is the year, MM is the month (01–12), and DD is the day of the month (00-31).	8	YYYYMMDD		<R>
PATCH_TOT	Patch Table. Total Number of Patches contained in this file, and therefore, the number of PATCH extensions. Not used for EO-IR imagery.	4	SAR: Spot: 0000 to 0001 Search: 0001 to 0999 EO-IR: 0000		R
MTI_TOT	MTI Total. Total Number of MTIRP extensions contained in this file. Each MTIRP identifies 1 to 256 moving targets. Not used for EO-IR imagery.	3	SAR: 000 to 999 EO-IR: 0000		R

5.4. BLOCK — Image Block Information.

Image Block Information is optional, but often needed for exploitation of imagery. The format for the user defined fields of the BLOCKA extension and a description of their contents are detailed in Table 5. BLOCK is placed in the Image Subheader. Where several Image Subheaders relate to a single scene BLOCKA is placed in the first Image Subheader.

Table 5. BLOCKA — Image Block Information Extension Format

(TYPE "R" = Required, "C" = Conditional, <> = null data allowed)

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
CETAG	Unique Extension Identifier.	6	BLOCKA	n/a	R
CEL	Length of Entire Tagged Record.	5	00123	Bytes	R
The following fields define BLOCKA					
BLOCK_INSTANCE	Block number of this image block.	2	01 to 99		R
N_GRAY	SAR: The number of gray fill samples. EO-IR: spaces	5	00000 to 99999 spaces		<R>
L_LINES	Line count.	5	00001 to 99999		R
LAYOVER_ANGLE	Layover Angle. SAR: The angle between the first row of pixels and the layover direction in the image; positive values indicate a clockwise direction, defaults to spaces. EO-IR: spaces.	3	000 to 359, spaces	degrees	<R>
SHADOW_ANGLE	Shadow Angle. SAR: The angle between the first row of pixels and the radar shadow in the image; positive values indicate a clockwise direction, defaults to spaces. EO-IR: spaces.	3	000 to 359, spaces	degrees	<R>
(reserved-004)		16	16 spaces		R
The following four fields repeat earth coordinate image corner locations described by IGEOLO in the NITF image subheader, but provide higher precision. The format Xddmmss.cc represents degrees (00-89), minutes (00-59), seconds (00-59), and hundredths of seconds (00-99) of latitude, with X = N for north or S for south, and Ydddmmss.cc represents degrees (000-179), minutes (00-59), seconds (00-59), and hundredths of seconds (00-99) of longitude, with Y = E for east or W for west. The format ±dd.dddddd indicates degrees of latitude (north is positive), and ±ddd.dddddd represents degrees of longitude (east is positive).					
FRLC_LOC	First Row Last Column Location. Location of the first row, last column of the image block.	21	Xddmmss.ssYdddmmss.ss, ±dd.dddddd±ddd.dddddd		R
LRLC_LOC	Last Row Last Column Location. Location of the last row, last column of the image block.	21	Xddmmss.ssYdddmmss.ss, ±dd.dddddd±ddd.dddddd		R
LRFC_LOC	Last Row First Column Location. Location of the last row, first column of the image block.	21	Xddmmss.ssYdddmmss.ss, ±dd.dddddd±ddd.dddddd		R
FRFC_LOC	First Row First Column Location. Location of the first row, first column of the image block.	21	Xddmmss.ssYdddmmss.ss, ±dd.dddddd±ddd.dddddd		R
(reserved-005)		5	010.0		R

5.5. SECTG — Secondary Targeting Information.

Secondary Targeting Information supports retrieval of imagery from automated libraries. Use of SECTG is optional. The format and descriptions for the user defined fields of the SECTGA extension are detailed in Table 6. As many as ten SECTGA extensions can exist in a single NITF file, with the N_SEC field of EXPLTA providing the total count. Either SEC_ID, SEC_BE, or both, must contain a valid identifier.

Table 6. SECTGA — Secondary Targeting Information Extension Format

(TYPE “R” = Required, “C” = Conditional, <> = null data allowed)

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
CETAG	Unique Extension Identifier.	6	SECTGA	n/a	R
CEL	Length of Entire Tagged Record.	5	00028	Bytes	R
The following fields define SECTGA					
SEC_ID	Designator of secondary target	12	Alphanumeric		<R>
SEC_BE	Basic Encyclopedia ID of secondary target, including the five character Target Category of the expanded BE.	15	Alphanumeric		<R>
(reserved-006)		1	0		R

5.6. BANDS — Multispectral Band Parameters.

The BAND extension is defined to replace or supplant information in the NITFS Image Subheader where additional parametric data is required, or where an image contains more than 9 spectral bands. This data extension is placed in each image subheader as required. The format and descriptions of the user defined fields of this are detailed in Table 7. Each Band must be identified either by the wavelength of peak response (BANDPEAK), or the wavelengths of its edges (BANDLBOUNDn, BANDUBOUNDn).

Table 7. BANDSA — Multispectral Band Parameters Extension Format

(TYPE “R” = Required, “C” = Conditional, <> = null data allowed)

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
CETAG	Unique Extension Identifier.	6	BANDSA	n/a	R
CEL	Length of Entire Tagged Record.	5	00050 – 45958	Bytes	R
The Following Fields Define DECIMA					
BANDCOUNT	Number of Bands comprising the image. Fields BANDPEAKn through BANDGSDn will be repeated for each band.	4	0001 - 0999	n/a	R
BANDPEAKn	Band n Peak Response Wavelength. Must be specified unless BANDLBOUNDn and BANDUBOUNDn are specified.	5	00.01 - 19.99	μm	<C>
BANDLBOUNDn	Band n Lower Wavelength Bound. The wavelength for the nth band at the lower 50% (-3db) point of the sensor spectral response.	5	00.01 - 19.99	μm	<C>
BANDUBOUNDn	Band n Upper Wavelength Bound. The wavelength for the nth band at the higher 50% (-3db) point of the sensor spectral response.	5	00.01 - 19.99	μm	<C>
BANDWIDTHn	Band n Width. The wavelength difference between the upper and lower bounds at the 50% (-3db) points of the sensor spectral response.	5	00.01 - 19.99	μm	<C>
BANDCALDRKn	Band n Calibration (Dark). The calibrated receive power level for the nth band that corresponds to a pixel value of 0.	6	0000.1 - 9999.9	μw / (cm^2-sr-μm)	<C>
BANDCALINCn	Band n Calibration (Increment). The mean change in power level for the nth band that corresponds to an increase of 1 in pixel value.	5	00.01 - 99.99	μw / (cm^2-sr-μm)	<C>
BANDRESPn	Band n Spatial Response. Nominal pixel size, expressed in microradians	5	000.1 - 999.9	μradians	<C>
BANDASDn	Band n Angular Sample Distance. The pixel center to center distance, expressed in microradians.	5	000.1 - 999.9	μradians	<C>
BANDGSDn	Band n Ground Sample Distance. The average distance between adjacent pixels for the nth band.	5	00.01 - 99.99	m	<C>

5.7. EXOPT — Exploitation Usability Optical Information.

The Exploitation Usability Optical Information extension is optional. EXOPT provides metadata that allows a user program to determine if the image is suitable for the exploitation problem currently being performed — it contains some of the fields which would make up a NIMA standard directory entry. The format and descriptions for the user defined fields of the EXOPTA are detailed in Table 8. A single EXOPT is placed in the Image Subheader, following AIMID.

Table 8. EXOPTA — Exploitation Usability Optical Information Extension Format
(TYPE "R" = Required, "C" = Conditional, <> = null data allowed)

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
CETAG	Unique Extension Identifier.	6	EXOPTA	n/a	R
CEL	Length data fields.	5	00107	Bytes	R
	The following fields define EXOPTA				
ANGLE_TO_NORTH	Angle to True North., Measured clockwise from first row of the image.	3	000 to 359	degrees	R
MEAN_GSD	Mean Ground Sample Distance. The geometric mean of the cross and along scan center-to-center distance between contiguous ground samples. Accuracy = ±10% Note: Systems requiring an extended range shall insert a default value of "000.0" for this field and utilize the PIAMC tag.	5	000.0 to 999.9	inches	R
(reserved-007)		1	1		R
DYNAMIC_RANGE	Dynamic Range of image pixels.	5	00000 to 65535		<R>
(reserved-008)		7	7 spaces		R
OBL_ANG	Obliquity Angle. Angle between the local NED horizontal and the optical axis of the image.	5	00.00 to 90.00	degrees	<R>
ROLL_ANG	Roll Angle of the platform body.	6	±90.00	degrees	<R>
PRIME_ID	Primary Target ID	12	Alphanumeric		<R>
PRIME_BE	Primary Target BE	15	Alphanumeric		<R>
(reserved-009)		5	5 space		R
N_SEC	Number of Secondary Targets in image. Determines the number of SECTG extension present.	3	000 to 250		R
(reserved-010)		2	2 spaces		R
(reserved-011)		7	0000001		R
N_SEG	Number of Segments. Segments are separate imagery pieces within an imaging operation.	3	001 to 999		R
MAX_LP_SEG	Maximum Number of Lines Per Segment. Includes overlap lines.	6	000001 to 199999		<R>
(reserved-012)		12	12 spaces		R
SUN_EL	Sun Elevation. Angle in degrees, measured from the target plane at intersection of the optical line of sight with the earth's surface at the time of the first image line. 999.9 indicates data is not available.	5	±90.0, 999.9	degrees	R
SUN_AZ	Sun Azimuth. Angle in degrees, from True North clockwise (as	5	000.0 to 359.9, 999.9	degrees	R

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
	viewed from space) at the time of the first image line. 999.9 indicates data is not available.				

5.8. MSTGT — Mission Target Information.

MSTGT provides information from the collection plan associated with the image, and should identify specific targets contained within the image (however, due to collection geometry, a referenced target may not actually correspond to the area contained in the image). Use of MSTGT is optional. The format and description of the user defined fields of MSTGTA are given in Table 9. As many as 256 instances of this data extension may occur in each NITF file.

Table 9 MSTGTA — Mission Target Information Extension Format

TYPE "R" = Required, "C" = Conditional, <> = null data allowed)

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
CETAG	Unique Extension Identifier.	6	MSTGTA	n/a	R
CEL	Length of Entire Tagged Record.	5	00072	Bytes	R
The Following Fields Define MSTGTA					
TGT_NUM	Pre-Planned Target Number. A number assigned to each preplanned target, initialized at 1. Recorded in the mission target support data block and the mission catalog support data block to associate the two groups of information. The same number may be assigned to multiple mission catalog support blocks. Each mission target block shall have a unique number.	3	001 to 999		R
TGT_PRI	Pre-Planned Target Priority: 1 = top priority 2 = second, etc.	3	001 to 999		<R>
TGT_REQ	Target Requester. Identification of authority requesting target image.	12	Alphanumeric		<R>
TGT_LTIOV	Latest Time Information of Value This field shall contain the date and time, referenced to UTC, at which the information contained in the file loses all value and should be discarded. The date and time is in the format YYYYMMDDhhmmZ, in which YYYY is the year, MM is the month (01–12), DD is the day of the month (01-31), hh is the hour (00-23), mm is the minute (00-59).	12	YYYYMMDDhhmm		<R>
TGT_TYPE	Pre-Planned Target Type: 0 = point 1 = strip 2 = area	1	0 to 9		<R>
TGT_COLL	Pre-Planned Collection Technique: 0 = vertical 1 = forward oblique 2 = right oblique 3 = left oblique 4 = best possible 5-9 = reserved	1	0 to 9		R

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
TGT_CAT	Target Functional Category Code from DIAM-65-3-1. The five character numeric code classifies the function performed by a facility. The data code is based on an initial breakdown of targets into nine major groups, identified by the first digit: 1 Raw Materials 2 Basic Processing 3 Basic Equipment Production 4 Basic Services, Research, Utilities 5 End Products (civilian) 6 End Products (military) 7 Places, Population, Gov't 8 Air & Missile Facilities 9 Military Troop Facilities Each successive numeric character, reading from left to right, extends or delineates the definition further.	5	10000 to 99999		<R>
TGT_UTC	UTC at Target. Format is hhmmssZ: hh = Hours, h = Minutes, ss = Secs, Z = time zone.	7	hhmmssZ		R
TGT_ELEV	Target Elevation, MSL. Planned elevation of point target. For strip and area targets, this corresponds to the average elevation of the target area. Measured in feet or meters, as specified by TGT_ELEV_UNIT.	6	-01000 to +30000	feet or meters	R
TGT_ELEV_UNIT	Unit of Target Elevation. f = feet, m=meters.	1	f or m		
TGT_LOC	Target Location. Planned latitude/ longitude of corresponding portion of target. Location may be expressed in either degrees-minutes-seconds or in decimal degrees. The format ddmmss.ssX represents degrees (00-89), minutes (00-59), seconds (00-59), and hundredths of seconds (00-99) of latitude, with X = N for north or S for south, and dddmmss.ssY represents degrees (000-179), minutes (00-59), seconds (00-59), and hundredths of seconds (00-99) of longitude, with Y = E for east or W for west. The format ±dd.dddddd indicates degrees of latitude (north is positive), and ±ddd.dddddd represents degrees of longitude (east is positive).	21	ddmmss.ssXdddmmss.ssY ±dd.dddddd±ddd.dddddd		R

5.9. RPC00 — Rapid Positioning Capability.

RPC00 contains rational function polynomial coefficients and normalization parameters that define the physical relationship between image coordinates and ground coordinates. Use of RPC00 is optional. The format and descriptions for the User Defined fields of the RPC00A extension is detailed in Table 10. A discussion of the polynomial functions is contained in Section 6.1.

Table 10. RPC00A — Rapid Positioning Capability Extension Format

(TYPE "R" = Required, "C" = Conditional, "<> = null data allowed)

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
CETAG	Unique Extension Identifier.	6	RPC00A		R
CEL	Length of Entire Tagged Record.	5	01041		R
The following fields define RPC00A					
SUCESS		1	1		R
ERR_BIAS	Error - Bias. 68% non time-varying error estimate, assumes correlated images.	7	0000.00 to 6553.50	meters	R
ERR_RAND	Error - Random. 68% time-varying error estimate, assumes correlated images.	7	0000.00 to 6553.50	meters	R
LINE_OFF	Line Offset	6	000000 to 524287	pixels	R
SAMP_OFF	Sample Offset	5	00000 to 54144	pixels	R
LAT_OFF	Geodetic Latitude Offset	8	±90.0000	degrees	R
LONG_OFF	Geodetic Longitude Offset	9	±180.0000	degrees	R
HEIGHT_OFF	Geodetic Height Offset	5	±8000	meters	R
LINE_SCALE	Line Scale	6	000001 to 524287	pixels	R
SAMP_SCALE	Sample Scale	5	00001 to 54144	pixels	R
LAT_SCALE	Geodetic Latitude Scale (cannot be ±00.0000)	8	±90.0000	degrees	R
LONG_SCALE	Geodetic Longitude Scale (cannot be ±000.0000)	9	±180.0000	degrees	R
HEIGHT_SCALE	Geodetic Height Scale (cannot be ±0000)	5	±8000	meters	R
LINE_NUM_COEFF_1 (through) LINE_NUM_COEFF_20	<u>Line Numerator Coefficients</u>. Twenty coefficients for the polynomial in the numerator of the r_n equation.	12 --- 12	±0.524287E±7 --- ±0.524287E±7		R --- R
LINE_DEN_COEFF_1 (through) LINE DEN_COEFF_20	<u>Line Denominator Coefficients</u>. Twenty coefficients for the polynomial in the denominator of the r_n equation.	12 --- 12	±0.524287E±7 --- ±0.524287E±7		R --- R
SAMP_NUM_COEFF_1 (through) SAMP_NUM_COEFF_20	<u>Sample Numerator Coefficients</u>. Twenty coefficients for the polynomial in the numerator of the c_n equation.	12 --- 12	±0.524287E±7 --- ±0.524287E±7		R --- R
SAMP_DEN_COEFF_1 (through) SAMP_DEN_COEFF_20	<u>Sample Denominator Coefficients</u>. Twenty coefficients for the polynomial in the denominator of the c_n equation.	12 --- 12	±0.524287E±7 --- ±0.524287E±7		R --- R

5.10. SENSR — EO-IR Sensor Parameters.

The SENSR provides information about the sensor and its installation. The SENSR extension is required. The format and descriptions for the user defined fields of the SENSR extension are detailed in Table 11. Imaging operations that require substantial time, for example push broom sensors, may require multiple SENSR extensions to adequately describe imaging geometry. The SENSR extension(s) are placed in the Image Subheader.

Table 11. SENSRA — EO-IR Sensor Parameters Extension Format

TYPE “R” = Required, “C” = Conditional, <> = null data allowed)

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
CETAG	Unique Extension Identifier.	6	SENSRA	n/a	R
CEL	Length of Entire Tagged Record.	5	00128	Bytes	R
The Following Fields Define SENSRA:					
REF_ROW	¨Reference Row. Data in this extension was collected at REF_ROW, REF_Col of the imaging operation. Identifies the time at which the data was valid during extended imaging operations.	8	00000000 to 99999999		<R>
REF_COL	Reference Column	8	00000000 to 99999999		<R>
SENSOR_MODEL	Sensor Model Name	6	Alphanumeric		<R>
SENSOR_MOUNT	Sensor Mounting Pitch Angle. Angle in degrees between the longitudinal centerline of the platform and the sensor scan axis. Normally only applicable to push broom sensors.	3	±45	degrees	<R>
SENSOR_LOC	Sensor Location. The earth coordinate sensor location may be expressed in either degrees-minutes-seconds or in decimal degrees. The format ddmmss.ssX represents degrees (00-89), minutes (00-59), seconds (00-59), and hundredths of seconds (00-99) of latitude, with X = N for north or S for south, and dddmmss.ssY represents degrees (000-179), minutes (00-59), seconds (00-59), and hundredths of seconds (00-99) of longitude, with Y = E for east or W for west. The format ±dd.dddddd indicates degrees of latitude north is positive), and ±ddd.dddddd represents degrees of longitude (east is positive).	21	ddmmss.ssXdddmmss.ssY ±dd.dddddd±ddd.dddddd	n/a	R
SENSOR_ALT	Sensor GPS Altitude. Measured in feet or meters, as specified by SENSOR_ALT_UNIT.	6	-01000 to +99000	feet or meters	<R>
SENSOR_ALT_UNIT	Unit of Sensor Altitude. Applies to both SENSOR_ALT and SENSOR_AGL, and may only be null if both altitudes are null. f = feet, m =meters	1	f or m		<R>
SENSOR_AGL	Sensor Radar Altitude. Measured in feet or meters, as specified by SENSOR_ALT_UNIT. Filled with spaces when not available, or outside equipment operating range.	5	00010 to 99000	feet or meters	<R>

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
SENSOR_PITCH	Sensor pitch angle. Angular position of the sensor optical axis, about the platform pitch axis. For push broom sensors, the angle between the platform roll axis Xa and the projection of the sensor scan axis onto the Xa, Za plane.	7	±90.000	degrees	<R>
SENSOR_ROLL	Sensor roll angle. Angular position of the sensor optical axis, about the platform roll axis.	8	±180.000	degrees	<R>
SENSOR_YAW	Sensor yaw angle. Angular position of the sensor optical axis, about the platform yaw axis.	8	±180.000	degrees	<R>
PLATFORM_PITCH	Platform pitch.	7	±90.000	degrees	<R>
PLATFORM_ROLL	Platform roll	8	±180.000	degrees	<R>
PLATFORM_HDG	Platform Heading.	5	000.0 to 359.9	degrees	<R>
GROUND_SPD	Ground Speed.	6	0000.0 to 9999.9		<R>
GROUND_SPD_UNIT	Unit of Ground Speed. May be null only if GROUND_SPD is null. K =knots, f =feet/sec., m =meters/sec.	1	k, f, or m		<R>
GROUND_TRACK	Ground Track. The angle from north to the horizontal projection of the platform path (positive from north to east).	5	000.0 to 359.9	degrees	<R>
VERT_VEL	Vertical Velocity. Measured in either feet/min. or meters/min. as specified by VERT_VEL_UNIT.	5	±9999	feet or meters per min	<R>
VERT_VEL_UNIT	Unit of Vertical Velocity. May be null only if VERT_VEL is null. f =feet/min., m =meters/min.	1	f or m		<R>
SWATH_FRAMES	Number of Frames per Swath. Swath is a continuous strip of frames swept out by the scanning motion of certain dynamic sensors.	2	01 to 99		<R>
N_SWATHS	Number of Swaths.	4	0001 to 9999		<R>
SPOT_NUM	Spot Number. Number in point target mode.	3	001 to 999		<R>

5.11. STERO — Stereo Information.

The STERO extension provides links between several images that form a stereo set to allow exploitation of elevation information. Use of STERO is optional. There can be up to 3 STREO extensions per image. The format and descriptions for the User Defined fields of the STREO extension is detailed in Table 12. The two images comprising a Stereo Pair are referred to as the *Left* and *Right* images; the Beginning and Ending Asymmetry, Convergence, and Bisector Elevation angles define the geometry between the two images (see Figure 5). The Beginning and Ending angles are always measured from the first and last lines, respectively, of the Left image, but measurement locations in the Right image are dependent on the rotation required to align the imagery (see Figure 4). When the two images are collected in succession along a flight path, the fore (aft) image is the Left (Right) image.

Table 12. STEROB — Stereo Information Extension Format

TYPE "R" = Required, "C" = Conditional, <> = null data allowed)

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
CETAG	Unique Extension Identifier.	6	STEROB	n/a	R
CEL	Length of Entire Tagged Record.	5	00094	Bytes	R
The Following Fields Define STEROB:					
ST-ID	Stereo Mate. The image id of the first stereo mate. This field contains the values of the fields ACQUISITION_DATE through END_TIL_ROW in the AIMID extension of the stereo mate image.	60	Alphanumeric		R
N MATES	Number of Stereo Mates. If there are no stereo mates, there will be no STERO extensions in the file. If there is a STREO extension, then there will be at least 1 stereo mate.	1	1 to 3		R
MATE_INSTANCE	Mate Instance. Identifies which stereo mate is described in this extension. For example, this field would contain a 2 for the second stereo mate.	1	1 to 3		R
B_CONV	Beginning Convergence Angle. Defined at the first lines of the left and /right images, unless those images are rotated more than 90 degrees to each other; If the images are rotated more than 90 degrees to each other, the last line of the right shall be used.	5	00.00 to 90.00	degrees	<R>
E_CONV	Ending Convergence Angle. Defined at the last lines of the left and right images, unless those images are rotated more than 90 degrees to each other; If the images are rotated more than 90 degrees to each other, the first line of the right shall be used.	5	00.00 to 90.00	degrees	<R>

FIELD	NAME	SIZE	VALUE RANGE	UNITS	TYPE
B_ASYM	Beginning Asymmetry Angle. Defined at the first lines of the left and right images, unless those images are rotated more than 90 degrees to each other; If the images are rotated more than 90 degrees to each other, last line of the right shall be used.	5	00.00 to 90.00	degrees	<R>
E_ASYM	Ending Asymmetry Angle. Defined at the last lines of the left and right images, unless those images are rotated more than 90 degrees to each other; If the images are rotated more than 90 degrees to each other, the first line of the right shall be used.	5	00.00 to 90.00	degrees	<R>
B_BIE	Beginning Bisector Intercept Elevation less Convergence Angle of Stereo Mate. Defined at the first lines of the left and right images, unless those images are rotated more than 90 degrees to each other; If the images are rotated more than 90 degrees to each other, the last line of the right shall be used.	6	±90.00	degrees	<R>
E_BIE	Ending Bisector Intercept Elevation less Convergence Angle of Stereo Mate. Defined at the last lines of the left and right images, unless those images are rotated more than 90 degrees to each other; If the images are rotated more than 90 degrees to each other, the first line of the right shall be used.	6	±90.00	degrees	<R>

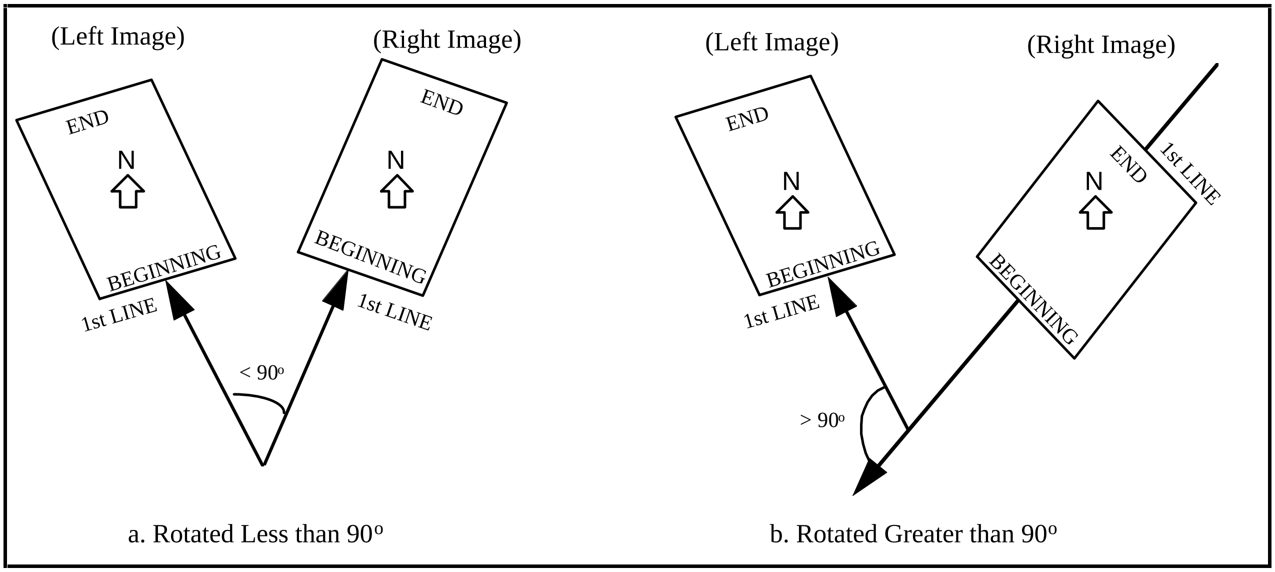

Figure 4 Location of Beginning/Ending Angles

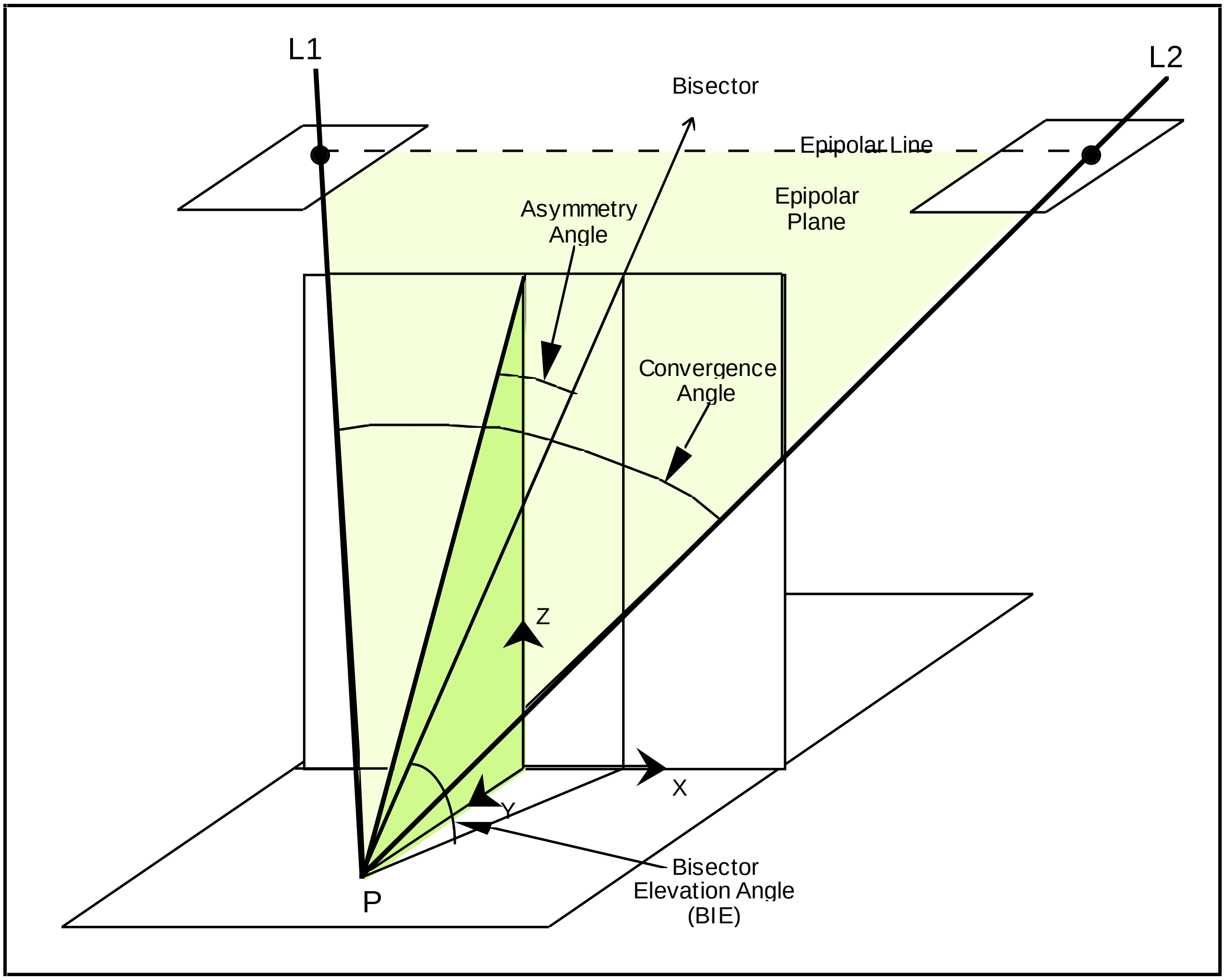

Figure 5 Asymmetry Angle, Convergence Angle and Bisector Elevation Angle

6. Notes

6.1. Projection Model for RPC00.

The geometric sensor model describing the relationship between image coordinates and ground coordinates is known as a Rigorous Projection Model (RPM). The RPM expresses the mapping of the image space coordinates of rows and columns (r,c) onto the object space reference surface geodetic coordinates (φ, λ, h).

The RPM approximation used by RPC00 is a set of rational polynomials expressing the normalized row and column values, (r_n, c_n), as a function of normalized geodetic latitude, longitude, and height, (P, L, H), given a set of normalized polynomial coefficients (LINE_NUM_COEF_n, LINE_DEN_COEF_n, SAMP_NUM_COEF_n, SAMP_DEN_COEF_n). Normalized values, rather than actual values are used in order to minimize introduction of errors during the calculations. The transformation between row and column values (r,c), and normalized row and column values (r_n, c_n), and between the geodetic latitude, longitude, and height (φ, λ, h), and normalized geodetic latitude, longitude, and height (P, L, H), is defined by a set of normalizing translations (offsets) and scales that ensure all values are contained in the range -1 to +1.

P = (Latitude	- LAT_OFF)	÷ LAT_SCALE
L = (Longitude	- LONG_OFF)	÷ LONG_SCALE
H = (Height	- HEIGHT_OFF)	÷ HEIGHT_SCALE
r_n = (Row	- LINE_OFF)	÷ LINE_SCALE
c_n = (Column	- SAMP_OFF)	÷ SAMP_SCALE

The rational function polynomial equations are defined as:

$$r_n = \frac{\sum_{i=1}^{20} LINE\_NUM\_COEF_i \cdot \rho_i(P, L, H)}{\sum_{i=1}^{20} LINE\_DEN\_COEF_i \cdot \rho_i(P, L, H)} \quad \text{and} \quad c_n = \frac{\sum_{i=1}^{20} SAMP\_NUM\_COEF_i \cdot \rho_i(P, L, H)}{\sum_{i=1}^{20} SAMP\_DEN\_COEF_i \cdot \rho_i(P, L, H)}$$

The rational function polynomial equation numerators and denominators each are 20-term cubic polynomial functions of the form:

$$\begin{aligned}\sum_{i=1}^{20} C_i \cdot \rho_i(P, L, H) = {} & C_1 && + C_6 \cdot L \cdot H && + C_{11} \cdot P \cdot L \cdot H && + C_{16} \cdot P^3 \\ & + C_2 \cdot L && + C_7 \cdot P \cdot H && + C_{12} \cdot L^3 && + C_{17} \cdot P \cdot H^2 \\ & + C_3 \cdot P && + C_8 \cdot L^2 && + C_{13} \cdot L \cdot P^2 && + C_{18} \cdot L^2 \cdot H \\ & + C_4 \cdot H && + C_9 \cdot P^2 && + C_{14} \cdot L \cdot H^2 && + C_{19} \cdot P^2 \cdot H \\ & + C_5 \cdot L \cdot P && + C_{10} \cdot H^2 && + C_{15} \cdot L^2 \cdot P && + C_{20} \cdot H^3\end{aligned}$$

where coefficients $C_1 \Lambda\ C_{20}$ represent the following sets of coefficients:

LINE_NUM_COEF_n, LINE_DEN_COEF_n, SAMP_NUM_COEF_n, SAMP_DEN_COEF_n

The image coordinates are in units of pixels. The ground coordinates are latitude and longitude in units of decimal degrees and the geodetic elevation in units of meters. The ground coordinates are referenced to WGS-84.